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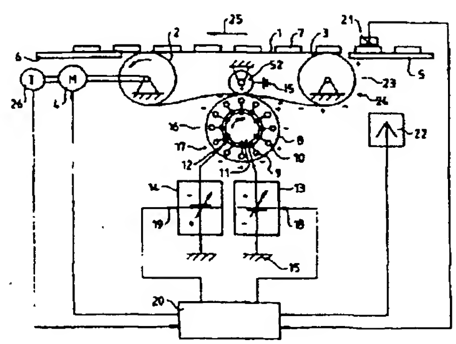
[54]发明名称 印刷机械的单张纸传送装置

[57]摘要

本发明的目的是提供一种用于薄工件传送的新装置，该传送装置具有简单的结构、长的使用寿命和对于工件及环境最小的静电影响。本发明的目的是这样实现的，即，设置至少一组接触构件（9，10，28，29，42，43，108，819，820），该接触构件与传送元件（1，103，301，401，501，601）的表面相接触，以产生电荷密度变化的区域。接触构件（9，10，28，29，42，43，108，819，820）延伸于工件（7，108，307，407，607）的整个宽度，并且至少与一直流电源（13，14，109，110，204，205，504）相连接。本发明可用于印刷技术领域的机器中，所传送的工件通过静电而被支承着。



权利要求书

1、一种用于印刷机械的薄工件传送装置，该装置至少包括一个可移动的传送元件，该传送元件的接触表面是电子绝缘性的，在传送过程中至少支持一个工件，通过将电荷施加到传送元件的接触表面上而形成一个电荷密度变化的区域，该工件借助于静电力而被支承于传送元件的表面上，

其特征在于，

至少设置一组接触构件（9，10，28，29，42，43，108，819，820）的接触元件（101，102，202，203，303，404，405，503），它们与传送元件（1，103，301，401，501，601）的表面相接触；接触构件（9，10，28，29，42，43，108，819，820）应沿横穿工件（7，118，307，407，607）的传送方向排列，并且应分布于整个工件（7，118，307，407，607）的宽度上；接触构件（9，10，28，29，42，43，108，819，820）与至少一个直流电源（13，14，109，110，204，205，504）相连接。

2、如权利要求1所述的装置，其特征在于，

至少设置两组接触构件的接触元件，它们与传送元件（1，103，301，401，501，601）的表面相接触，不同组的接触构件（9，10，28，29，42，43，108，819，820）可选择地与不同电势的直流电源（13，14，109，110，204，205，504）相连接。

3、如权利要求 1 所述的装置，其特征在于，

每一组接触构件（9，10，28，29，42，43，108，819，820）的接触元件都由同轴设置的等直径线圈组成，这些线圈在传送元件（1，103，301，401，501，601）的表面上缠绕，并且彼此相互连接以进行导电。

4、如权利要求 1 所述的装置，其特征在于，

接触构件（9，10，28，29，42，43，108，819，820）的所有组的接触元件彼此同轴设置。

5、如前述任一权利要求所述的装置，其特征在于，

接触构件（9，10，28，29，42，43，108，819，820）都设置于一个由绝缘材料构成的圆柱体上。

6、如前述任一权利要求所述的装置，其特征在于，

接触构件（9，10，28，29，42，43，108，819，820）在与传送方向相垂直的方向上的距离的设定取决于所传送的工件（7，118，307，407，607）的尺寸。

7、如权利要求 1 所述的装置，其特征在于，

与传送元件（501）的表面相接触的一组接触元件（503）与一直流电源（504）相连接；在传送方向上，一静电荷装置（505）设置于接触元件组（503）的前面，利用该电荷装置（505），可在传送元件（501）的表面产生同质的电荷，其电位是与直流电源（504）的电位相反的。

说　　明　　书

印刷机械的单张纸传送装置

本发明涉及一种用于印刷机械的单张纸传送装置。

人们熟知通过静电装置来支持和传送纸张。US4，244，465 中公开了一种装置，利用该装置，纸张在传送带上传送，在该装置中传送带上有两组窄条形的等间距的电极结为一个整体。该电极被绝缘材料包围并连接到高压电源上，因此就形成了一个横穿传送带表面的静电场。但这种装置有一个缺点，就是电极绕在传送带上，这样会磨损和撕裂电极并且需增加传送带。另外，这种结构的电极高出传送带的表面，导致纸接触面不完全平滑，这会影响薄纸页的传送和加工。作用于纸页上的力也减小，因此需要更换高极性电压。由电极产生的不均匀电场不能完全由纸页补偿，这又导致传送带上灰尘的增加。随着纸页从传送带表面移走，会随之而来产生电晕放电现象，通过这种电晕放电，电荷在覆盖电极的绝缘层上积累。这样，传送带表面就可能会变成无电的，从而使得作用在该纸页上的支持力消失。

US4，526，357 公开了一种基于与上述同样的原理而设计的一种纸页分离装置。

EP0297227A2 揭示了一种静电支承装置，该装置上具有成对地嵌装于基材中的电极，该电极与可选择地变换极性的电源相连接。

DE4012510A1 公开了一种纸页传送装置，该装置上有一个循环

带，带材中没有电极。借助于一个横跨带子宽度并与一交流电源相连接的电极，通过接触而在带子的表面上形成一电荷密度分布图型。所得到的非均匀电场在纸页材料上产生反射电荷，由此产生支持力，使纸页保持在带子的表面上。

为了得到均匀的支持力，交流电源的频率应当与带子的旋转速度同相。然而，这需要增加一笔用于控制系统的支出费用。当这种同相状态不能完全实现时，例如正电荷场会由于随之的带子旋转而被充上负电荷。电荷的这种变化产生电晕放电现象，通过电晕放电效应，使臭氧和二氧化氮逃逸而进入周围环境。能量的消耗增加了。特别是当带子表面上的正电荷场与负电荷场之间的空间很小时，在带子进入和退出电荷电极的作用范围时，电荷将发生更多的改变。

交流电源的使用增加了沿传送带的绝缘表面滑动放电的趋势。由于带子表面上存在有有限的欧姆电阻，因此电荷间的距离大于 1mm 是理想的。这使得纸页以下述方式放置在带上，即，纸页的边缘距电荷极值处有一定的距离。这种方式又使最大支持力不会作用于纸的边缘，而这个力会有许多用途 。

DE4012510A1 公开了一种刀片形电极或是一个有很大空间范围的充电辊。在使用高压交流电时，电流控制回路会产生电容性干扰，而这只能靠设置附加的屏蔽或过滤装置等才能减少。

如果充电辊同时作为张力辊作用于内层具有导电性的传送带上，那么在充电辊与传送带之间就确实存在一高电容。当施加交流电压时，导致高功率和高能量的消耗。

US3，726，520 中公开了一种分离装置，是将纸张从纸堆顶端移走，在这种装置中，用一个周期性相互移动的金属箔或者是一个被电晕充电电源充电到一限定的电位的循环带作为传送元件。当传送的纸张到达时，它被吸附到充电的传送元件上并被支承在其上，直到传送元件完成放电。纸张也可通过静电传导作用而被充电，但这样会存在这样的危险，即，在离开传送元件后，纸张会拥有剩余电荷，这电荷会成为进一步传送或加工纸张时的障碍。尤其是在静电印刷装置中，印刷材料上的剩余电荷是导致印刷错误的原因。

本发明的目的就是提供一种用于传送薄工件、使其穿过或通过印刷机械的装置，在该装置中，用于传送薄工件的传送元件结构简单，并且其表面的结构也不会阻碍在各机器上进行传送和加工，并且具有长的工作寿命。另外，残留在薄工件上的剩余电荷或净电荷以及负面的环境影响也减到最小限度。

为实现本发明的目的，提供一种具有权利要求 1 所述特征的装置。从属权利要求中的特征表明了最佳实施例。

可用传送带或滚筒体作为传送元件。该传送元件一般包括一层均匀的非导电材料层。在与片材相接触的传送元件的表面上由一恒定变换的电极施加电荷。这样可以使传送元件传送各种类型的薄片材料，不均匀的电场作用力作用在该薄片材料上。一种特别适用的薄片材料就是普通的纸张。

在多机组的印刷机中，互相平行排列着多个传送元件。根据需要，该传送元件可设计成带子，带子具有直线型的传送通道或具有

呈任意弧形的通道，呈任意弧形的通道借助于导引件而工作。如果各机器加工需要，则传送元件与纸页接触的表面可以不是平的，而纸页可由于静电力的存在基本上呈接触面的形状。

没有电极嵌入传送元件，因为在采用带型传送元件的情况下，这些电极会过早地磨损。基于这个事实，在电极被置入载体上时，极性相反的电荷就被施加到传送元件的绝缘层上，因此纸张上几乎没有会影响纸张的下一步传送的剩余电荷或净电荷。电荷量几乎是完全相等的，因此朝向传送元件的绝缘层的外部是不带静电的。至少在传送过程中电荷是保证的。绝缘层表面的传导性是这样定的，即，在传送过程中支持力减小并且在传送通道的末端这种支持力几乎整个消失。

可以在施加新电荷之前中和现存的电荷，这样，在传送元件的一确定的区域内不带极性。适宜用作绝缘层的材料（在所说的绝缘层上所施加的电荷被部分地保持）是适用的合成材料比如聚酯、聚碳酸酯、聚酰亚胺或者 PTFE。

为了保持传送元件上作用于纸页上的力恒定，可以操纵用变化的电压产生电荷的装置，或者设置或改变以某种方式在传送带上施加电荷的电极间的距离，这样所需要的支持力的分布和大小就可遍布于接触表面。当被印刷的或被涂布的纸张被传送时，就会相应于被印刷的图像或涂层进行电荷分布，并且产生局部数量的电荷。

由于电子电荷在很大程度上取决于空气条件和取决于传送元件及纸页的材质性能的改变，因此根据这些条件或性能可以改变电荷

的分布和改变所施加的局部电荷量。为达到这个目的，可用各传感器进行探测，比如探测湿度、气压、空气温度以及纸质材料的湿度。可将探测信号传输给控制装置，该控制装置在处理这些信号之后驱动产生电荷的装置的各调节元件。这样就可控制电荷的分布和局部电荷量，或者说使电荷分布均匀。

从下面结合附图对实施例的描述中将能清楚地看出本发明的其它特征和优点。

图 1 是包括带型传送元件的装置的示意图；

图 2 是充电辊的侧视图；

图 3 是电荷分布的示意图；

图 4 是带有环形电极的充电辊；

图 5 是使用环形电极时电荷分布的示意图；

图 6 是带有螺旋形电极的充电辊；

图 7 是使用螺旋形电极时电荷分布的示意图；

图 8 表示的是一种带有两个充电辊和一个单层传送带的结构；

图 9 表示的是一种带有一根充电辊的结构，该充电辊具有两组环形接触线圈；

图 10 表示的是一种带有两个充电辊和一个双层传送带的结构；

图 11 表示的是一种带有一个充电辊和一个双层传送带的结构；

图 12 表示的是在一个双层传送带上带有一个充电辊和一个接地辊的结构；

图 13 是沿传送带分布的印刷装置的示意图；

图 14 是充电辊的一个实施例；

图 15 是图 1 所示装置的运转方式的流程图。

在图 1 所示的装置中，传送带 1 缠绕在两个导轮 2 和 3 上。传送带 1 的组成材料是绝缘材料。导轮 2 与用于驱动的电动机 4 相连接。该装置还包括一续纸台 5 和一用于被传送的纸页 7 的输送台 6。充电辊 8 与传送带 1 的下部相接触，它通过摩擦而与传送带一起转动。在充电辊 8 的对面，接地辊 52 在传送带 1 的内部反向旋转，该接地辊 52 与接地电位 15 相连接。在充电辊 8 的表面设置有两组电极 9 和 10，它们通过可滑动线圈 11 和 12 与可调节高压电源 13 和 14 相连。

电极 9 在接地电位 15 的对面与负电位 16 相连，同时电极 10 与正电位 17 相连。高压电源 13 和 14 具有可控输入端 18 和 19，可控输入端 18 和 19 与控制装置 20 相连。控制装置 20 还与湿度传感器 21 和 22 相连，湿度传感器 21 和 22 用于检测纸页 7 的表面湿度和检测充电辊 8 的周围环境中的湿度。控制装置 20 除了与湿度传感器 21、22 相连，更进一步还与没有在图中标出的传感器相连，比如与用于检测大气压及空气温度的传感器相连。

图 2 示出了均衡分布的电极 9 和 10 延展至充电辊 8 的整个宽度。

为了传送纸页 7，传送带 1 由交替电极来充电。图 3 中例举了电荷 23 和 24 在传送带 1 的接触面上分布的情况。按照图 2 中所示的电极 9 和 10 的设置，在传送方向 25 上负电荷 23 与正电荷 24 是一系列地交替分布。传送带 1 上的电荷是通过充电辊 8 而得到的。

通过可控输入端 18 和 19 的控制电压来设置高压电源 13 和 14，从而获得基本相等的电压。在接地辊 52 的对面在电极 9 和 10 上形成一静电场，通过与传送带 1 接触以及通过电晕效应，在传送带 1 上实质已形成电极。当纸页 7 落在带上时，在相对于传送带 1 的表面垂直的方向上产生的力作用于纸页 7 上。在传送通道的末端，纸页 7 就通过一个移动装置（图中未标示）从传送带 1 上移到输送台 6 上。传送带 1 的表面电阻的大小是这样定的，即，在到达输送位置之前电荷 23 和 24 由于漏电而一直是相等的。仍然存在的支持力可容易地由前面所说的移动装置克服。局部电荷量可依湿度传感器 21 和 22 的信号而改变。而且，当所述信号被与电机轴相连的增量旋转编码器 26 处理时，电动机 4 的速度及所施加的电荷量可通过控制装置 20 进行调整。

在图 4 中示出了充电辊 27 的又一个实施例。电极 28、29 以环形方式在圆周方向上嵌于充电辊 27 的表面。每个第二电极 28 和 29 均与前一个电极相连并且均置于滑动环 30 和 31 上。当直流电压基本上是对称性地提供给滑动环 30 和 31 上时，图 5 所示的电荷分布情形就会在传送带 1 的表面上产生。除开前面已经提到的直流电压依据传送速度、环境湿度及纸页 7 的湿度而变化外，该直流电压也根据纸页 7 的大小及间距以及根据纸页 7 上所印刷的图像的不同而不同。从这一点来说，沿传送通道可设置一边缘测量器及一图像曝光装置，其信号可在一控制装置中进行处理。

图 6 示出了具有两个电极 42、43 的充电辊 41 的实施例，这两

个电极 42 和 43 以螺旋形方式缠绕在充电辊 41 的表面上。因此电荷 23 和 24 在传送带 1 的绝缘层 39 上分布的均等性可得到提高。在图 7 中示出了电荷分布情况。

如果传送带 1 的绝缘层需要一强大的支持力，会设置前面所述的充电辊 8、27、41 当中的两个，这两个充电辊可同时旋转并且可一个紧接一个地安放。这样可以改变电荷区域分布。

本发明并不仅限于这里所示的设置。可用多个传送带 1 混合安置，也可用传送带 1 与一个或多个传送滚筒配合协同作业。还可以以接触或非接触式的排列方式在一个传送构件 1 上设置多个充电装置，这同样在传送通道上产生电荷 23 和 24。

当使用一单层的绝缘材料传送带 1 时，充电装置也可作用在与纸页 7 的充电表面相背对的那一侧上，因此纸页 7 的材料能用作反电极，或者用接地的固定辊作为反电极。在后一种情况下，也可在非导电的基片上实现力的作用。而且，这还有个好处是在续纸及移动纸页 7 的过程中灰尘影响电荷的情形会改善。

图 8 示出了有两个充电辊 101 和 102 的传送装置的实施例。传送带 103 由两个导辊 104 和 105 及一个张力辊 106 支承。导辊 104 与一驱动电机 107 相连。充电辊 101 和 102 分别由等距和同轴安置的环线 108 组成。这些充电辊 102 和 101 上的环线 108 都连接相同的电位。充电辊 101 上的环圈与负的直流电源 109 相连，充电辊 102 上的环圈 108 与正的直流电源 110 相连。每个直流电源 109 和 110 都由一高压转换器 111、一系列的电容器 112、二级管 113 及附加电

阻 114 组成。在围绕导轮 104 的环形区域中，充电辊 102、101 或线圈 108 与传送带 103 表面接触。导轮 104 与零电位相连。当传送带 103 移动时，充电辊 101 和 102 上的线圈 108 滑离传送带 103 的表面。通过沿轴线方向在充电辊 101 和 102 上设置线圈 108，围绕两线圈之间距离的一半在传送带 103 的表面会产生电荷分布 115（图 8 中所示仅仅为其一部分）。该电荷分布 115 包括正电荷 116 与负电荷 117 的排列。该电荷排列是沿着传送的方向并且象线圈 108 一样彼此具有同样的间距。单纸张页 118 就是由电荷 116 和 117 的电荷作用力支持于传送带 103 的表面上的。

图 9 所示的是只有一个充电辊 201 的另一种实施例。这个充电辊由两组接触线圈 203 和 202 组成，这两组线圈同轴且彼此之间可相互替换。接触线圈 202 和 203 每组都与一极性相反的直流电源 204 和 205 分别连接。

图 10 所示的是一个双层传送带 301 的实施例。为在传送带 301 的表面产生电荷分布，在所述的传送带的下部 302 有两个充电辊 303 和 304，所述充电辊 303 和 304 安装在一可转动的支撑件 305 和 306 上。充电辊 303 和 304 在传送带 301 上产生压力，因此该传送带被张紧。传送带 301 与纸页 307 相接触的那个表面由绝缘材料组成，而传送带 301 的在导轮 308 和 309 上移动的内表面是导电的。与图 8 和图 9 所示的单层结构的传送带 301 相反，图 10 所示的实施例使得传送带的环形区域 310 以外的部分都会产生有效的支持力作用于所放置的纸页 307 上，这是因为产生了镜像型的电荷。

图 11 示出了与图 9 所示实施例类似的另一个实施例，但这个实施例具有双层结构的传送带 401。充电辊 403 置于传送带 401 的下部 402 上，充电辊 403 由两组接触线圈 404 和 405 组成，就象图 9 中的充电辊 201 一样。该充电辊 403 与用于张紧传送带 401 的压力辊同时工作。当传送带上的纸页 407 通过印刷装置 406 时，该纸页可被所述的印刷装置印刷。

图 12 所示的又一个实施例具有这样的特征，即，对一个双层结构的传送带 501 只给定了一个仅带有一组接触线圈 503 的充电辊 502。接触线圈 503 与一直流电源 504 相连。一接地辊 505 被安置于充电辊 502 前面。当传送带 501 绕着导轮 506 和 507 移动时，传送带 501 表面仍存留的电荷密集分布会被消除。在接地辊 505 和充电辊 502 之间，传送带 501 下部的表面是呈中性的或为零电势处。通过与正极性直流电源 504 相连的接触线圈 503，在传送带 501 的表面会形成一个与接触线圈 503 的分布间距相一致的正电荷分布带，在图 12 中部分地显了这个情形。

在未图示的另一个可替换的实施例中，接地辊 505 可与一负直流电源相连接。在这种情况下，通过接触线圈 503 负电荷会变为正电荷，因此在接触线圈 503 之间的电荷将保持在负电位状态。由此而形成的电荷密集分布是相应的，比如具有图 11 所示的那种分布情况。

图 13 所示的是传送装置也可成为印刷装置的一部分。4 个印刷装置 603 至 606 可如图 13 所示置于传送带 602 的上部 601 处，这样，

一传送的纸页 607 就可被印刷上四种颜色。产生于传送带 602 上的电荷可被减少，那么为了将印刷油墨或调色剂从印刷装置 603 至 606 转移到纸页 607 上，静电力可作用于印刷油墨或调色剂上。

图 14 表示了曾用于图 4、图 9 和图 11 中的充电辊的另一种可替换的结构。

充电辊由一轴 801 及两线性终端 802 和 803 组成。电子绝缘部件 805 螺旋型连接于轴 801 的桥台形表面 804 上。在外螺纹 806 和部件 805 的桥台形表面 807 上，导电的管状部件 808 与其螺旋式相接。部件 808 被绝缘部件 809 和 810 包围。部件 808 具有一凸缘的末端。当部件 808 与正直流电源相连接时，法兰盘 811 的外层表面形成第一个带正电荷的接触表面。轴 801 置于一个圆柱形的电子绝缘部件 812 中，部件 812 具有与部件 805 外层最大直径相同的直径。匀电盘 813 和 814 安嵌于部件 812 的外层表面。用于正电势的匀电盘 813 与法兰盘 811 的正面相接触。而匀电盘 814 与管状部件 816 的法兰盘 815 相接触，管状部件 816 螺旋式连接于线型终端 803 上。在法兰盘 815 的外表面形成一个负电荷接触面，而同时部件 816 与一负直流电源相连接。部件 816 由绝缘部件 817 和 818 包围。在部件 812 的外层表面安装有成组的接触线圈 819 和 820，在其间有绝缘圆盘 821。第一组接触线圈 819 与匀电盘 813 相接触，因而与正电势位相连。第二组接触线圈 820 与匀电盘 814 相连而且有一个负电位。接触线圈 819 和 820 均有凹入接口 822 和 823，以便能通过极性相反的匀电盘 813 和 814。在部件 812 的外层部分以及在接触

线圈 819 和 820 的里面有一个半圆柱形的接口 824 和 825，其中插入有一圆柱形绝缘部件 826，以确保接触线圈 819 和 820 反向旋绕。匀电盘 813 和 814 通过螺钉 827 而紧固于部件 812 中。部件 806 和 816 与直流电源的连接情况在图中没有表示出来。这些连接可以通过传统的滑动连接来完成。

下面将根据图 15 和图 1 中所示的内容描述与纸页 7 通过印刷机时的传输相关联的控制装置 20 的功能：

图 15 所示的流程图包括：启动步骤 701，执行预启动的步骤 702。在步骤 702 中，所有排序好的相关数据，如纸张类型、纸张厚度、纸张湿度、纸张规格以及印刷次数均被输入。在步骤 703 中，传送带 1 上的纸页 7 所需的印刷压力值 P 以及纸页 7 的材质所具有的传导率 ae 场需从这些特别的数据中计算出来。在计算所需的印刷压力 P 值时需考虑的有印刷速度 V、纸页 7 材质中的场强 E 以及印刷时作用于纸页 7 上的力 F。纸页 7 的传导率 ae 由纸页 7 的材料性质和由纸页湿度传感器 21 测出的湿度 H_{21} 所决定。在步骤 704 中，传送带 1 上所需的电荷分布值 Q 由在步骤 703 中计算出的印刷压力值 P 计算得出，因此，要考虑电极 9、10 彼此之间的距离。在下一步骤 705 中，计算电压值 U_{13} 和 U_{14}，该数值取决于在步骤 704 中计算出的电荷分布值 Q、传送带 1 的速度 V 以及环境湿度 H_{22}。湿度值 H_{22} 由湿度传感器 22 测得。在上述步骤 702 至 705 中的预启动和计算之后，在步骤 706 中电动机 4 就可以开动了。在步骤 707 中，确定传送带当前的速度 Vist 是否与基准速度 Vsoll 相符，然后在步骤 708

中调整电机 4 的转数。当达到基准速度 Vsoll 时，在步骤 709 中将电压值 U_{13} 和 U_{14} 施加到电极 9 和 10 上。当纸页 7 由传送带 1 一送入印刷装置，就在步骤 711 中使印刷装置进入操作状态。在纸页 7 的印刷过程中，在步骤 711 中有规律地进行检查，看当前材质的纸页中的场强 Eist 是否与基准场强 Esoll 相一致。当当前的场强 Eist 大于基准场强 Esoll 时（该值在步骤 712 中进行检测），步骤 713 中发出"有错误"的信息，在步骤 714 中产生正确的信号，借助于该正确的信息在步骤 715 中再重新计算电压值 U_{13} 和 U_{14}。在步骤 716 中，检测传导率 ae 是否因纸页 7 的表面湿度 H_{21} 的变化或空气中的湿度 H_{22} 的变化而变化。如果发生变化，则在步骤 715 中根据该传导率的变化校正电压值 U_{13} 和 U_{14} 。在步骤 717 中，检测电压值 U_{13} 和 U_{14} 是否超过最大电压值 Umax。如果超过了，则在步骤 718 中发出 "有错误"的信息。如果电压值 U_{13} 和 U_{14} 处于允许值的范围内，则在步骤 719 中，通过可控输入端 18 和 19 将高压电源 13 和 14 设定到新值 U_{13} 和 U_{14} 。在步骤 720 中，传送带 1 的速度 Vist 连续地与基准速度 Vsoll 相比较。如果与基准速度 Vsoll 发生偏离，就在步骤 721 中进行速度调整。最后，在步骤 722 中连续地检测所给出的纸页 7 是否已全部被印刷，如果没有全部印刷，则重复进行步骤 711 至步骤 722，直到达到预置的纸张数。在步骤 723 完成该印刷作业。

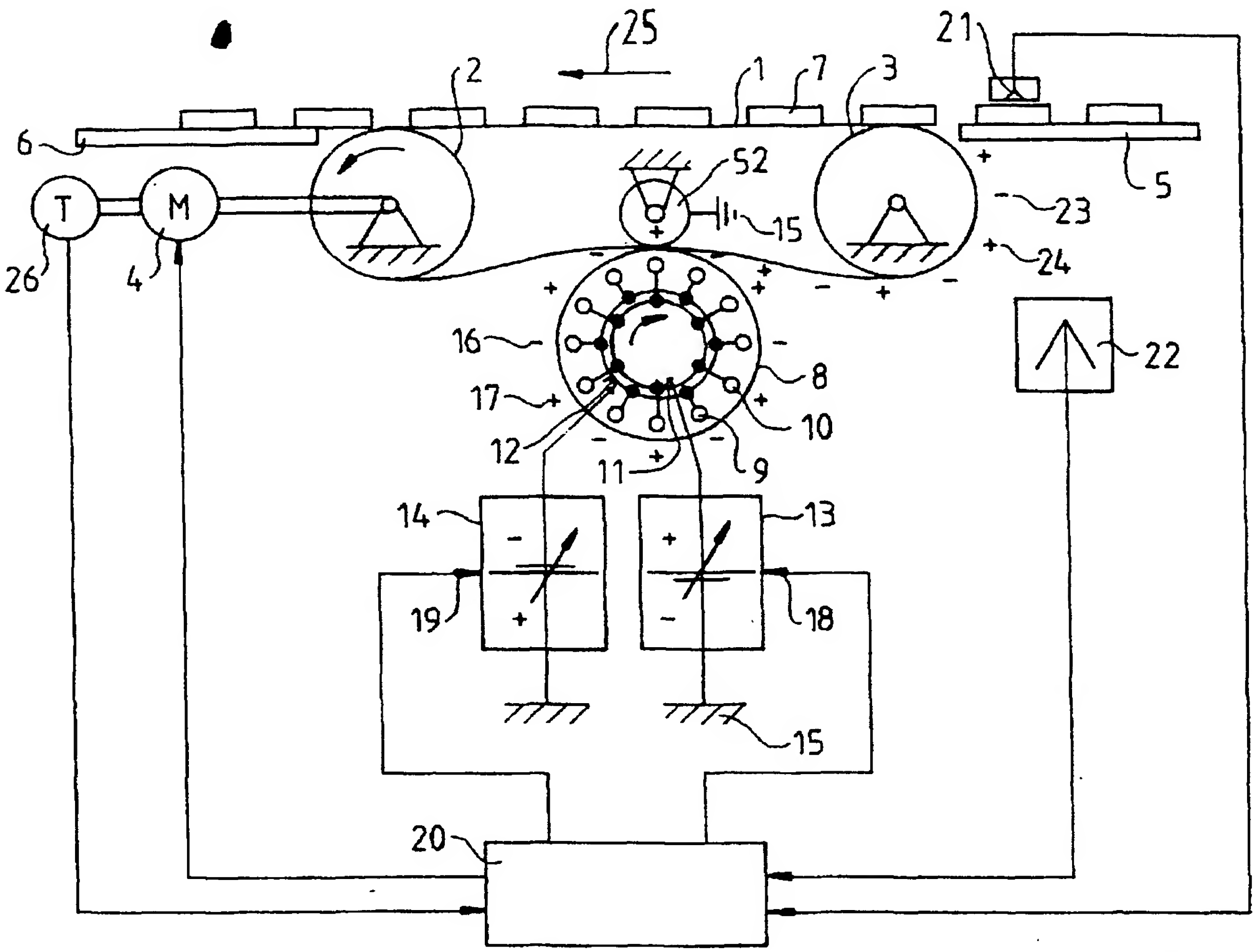

25
21
2
1
7
3
6
52
T
M
5
15
23
26
4
24
16
22
8
17
10
12
11
9
14
13
19
18
15
20

图 1

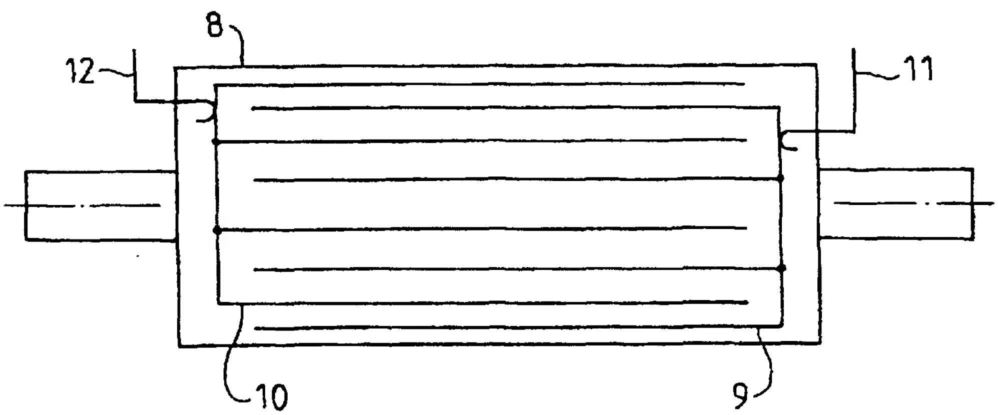

8
12
11
10
9

图 2

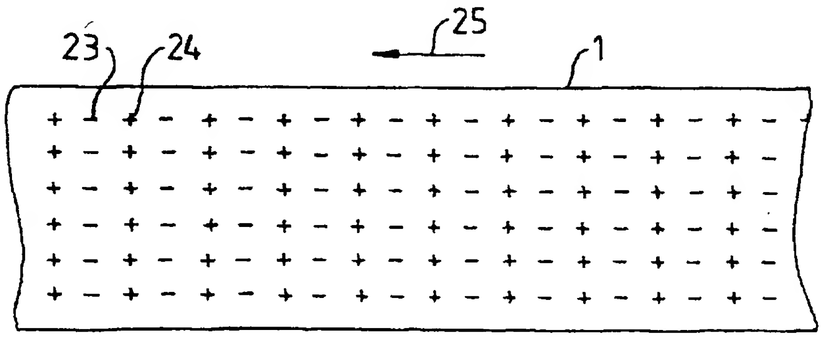

23
24
25
1

图 3

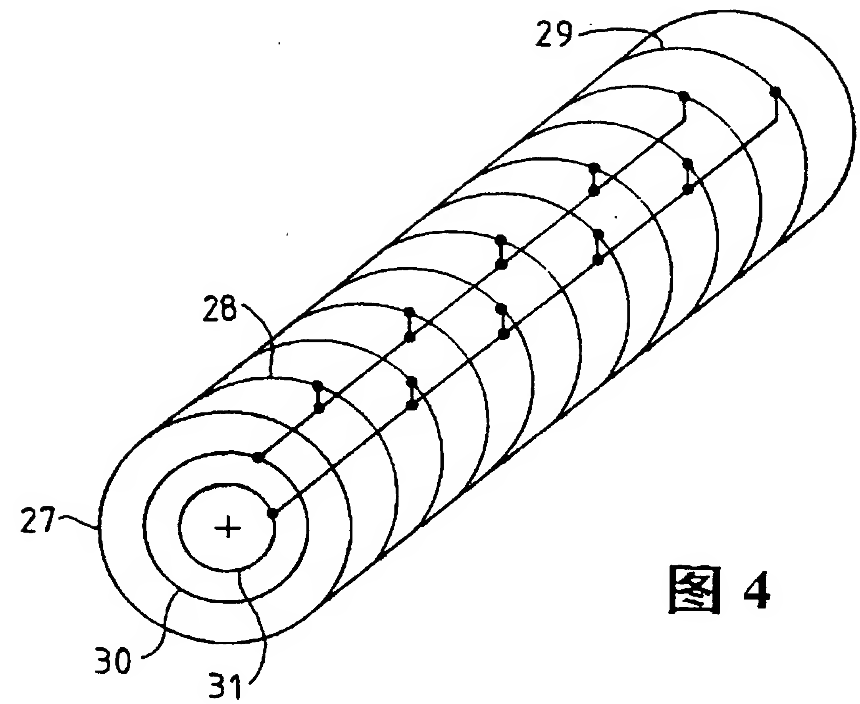


图 4

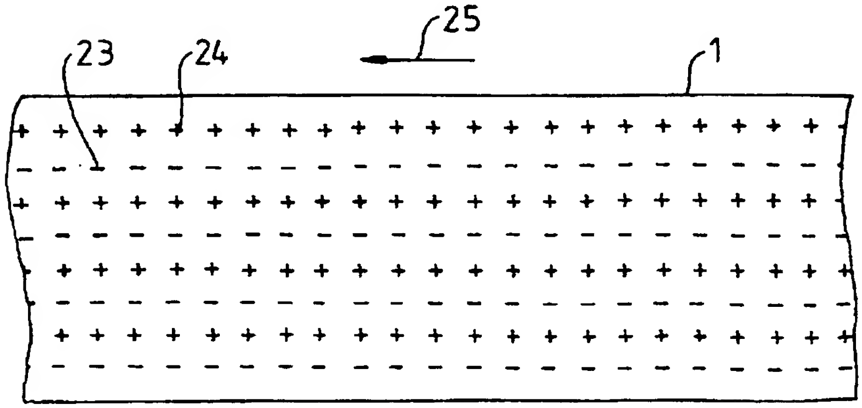


图 5

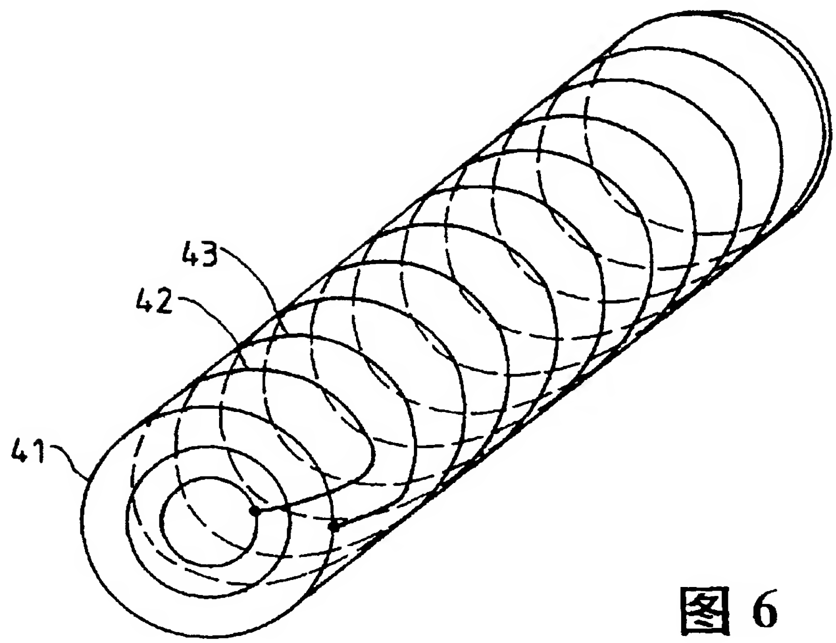


图 6

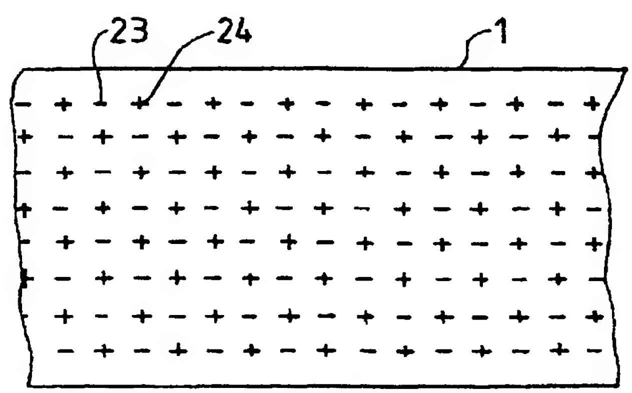
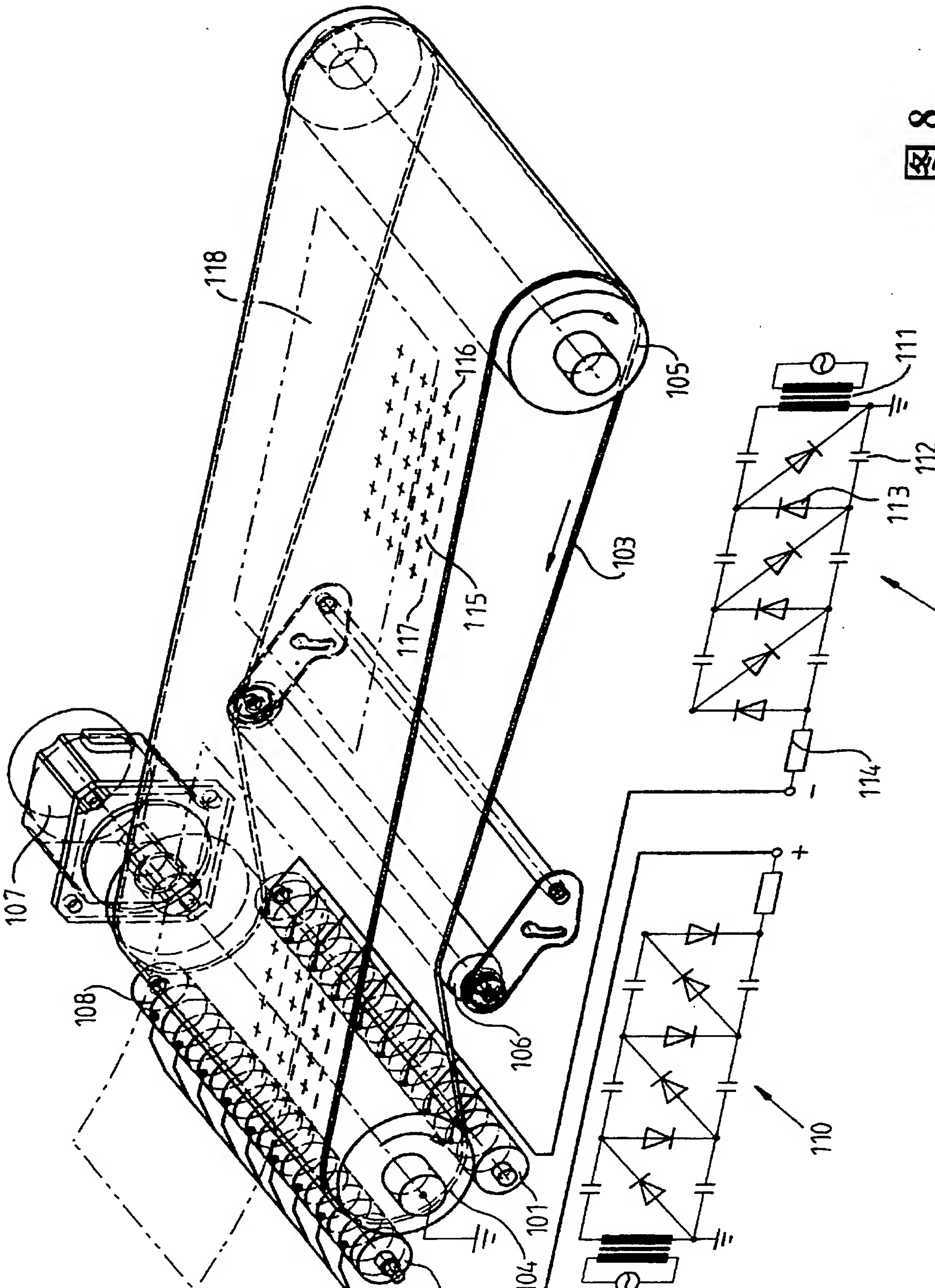


图 7



101
102
103
104
105
106
107
108
109
110
111
112
113
114
115
116
117
118
+
-

图 8

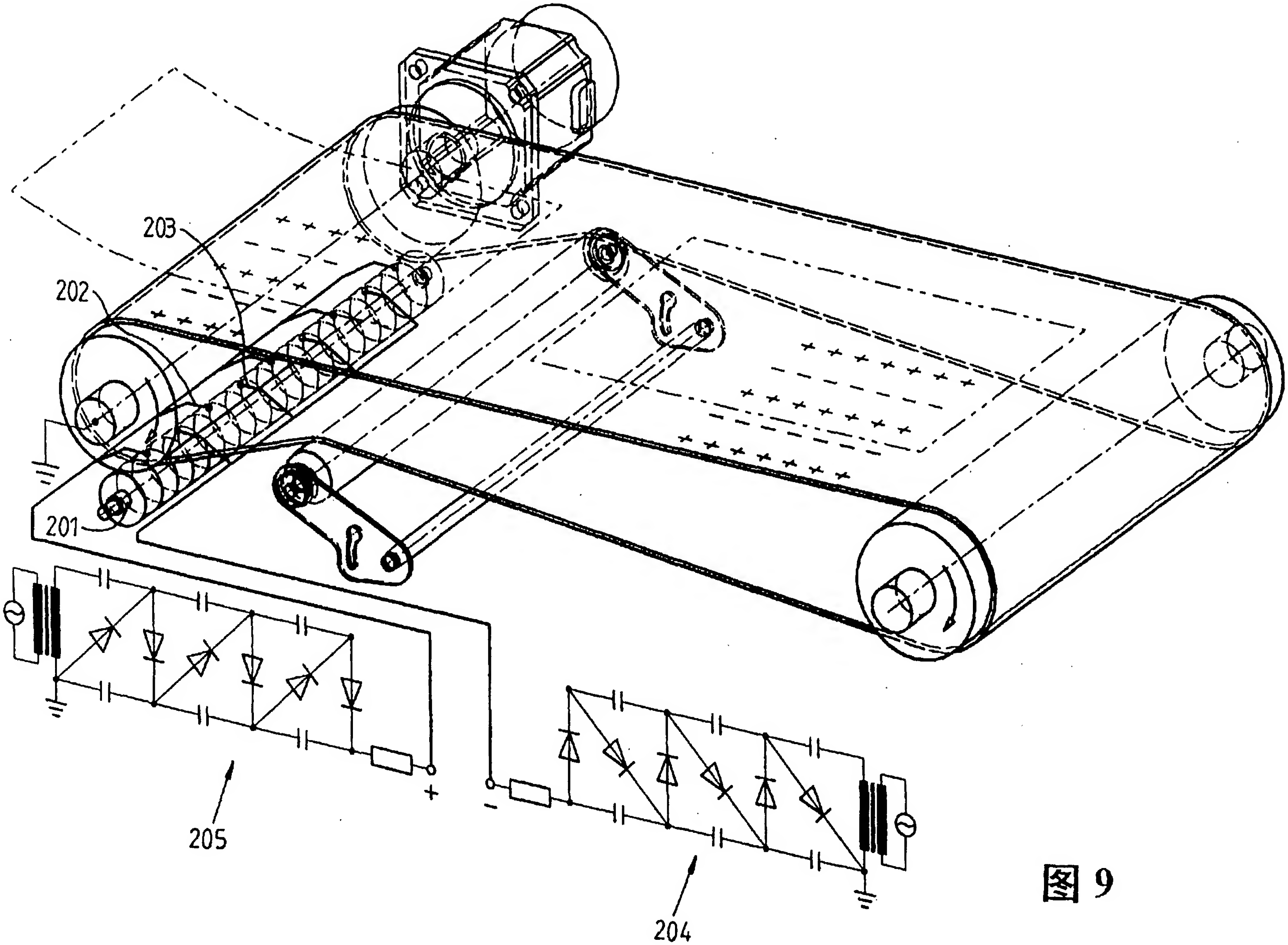


图 9

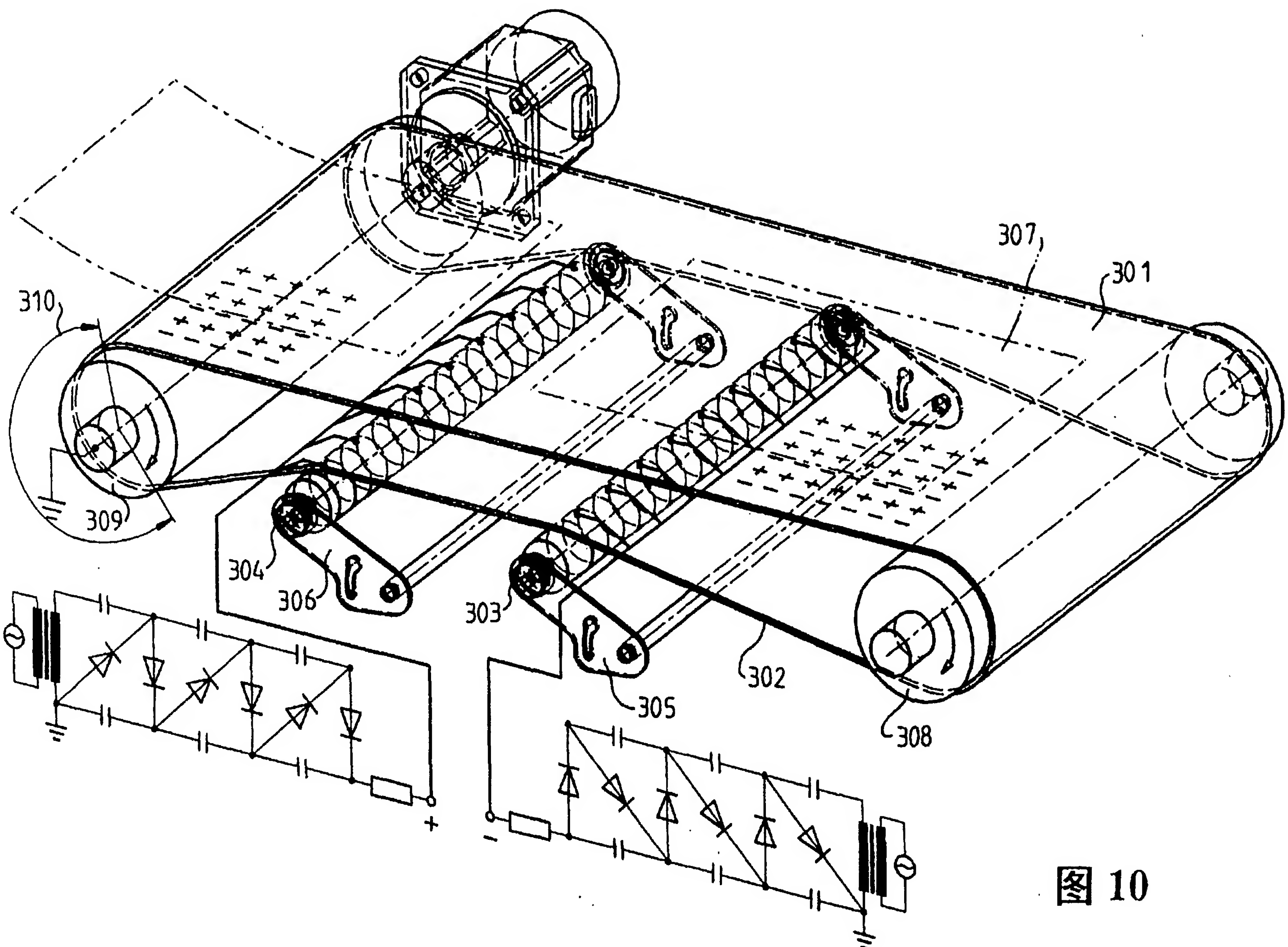


图 10

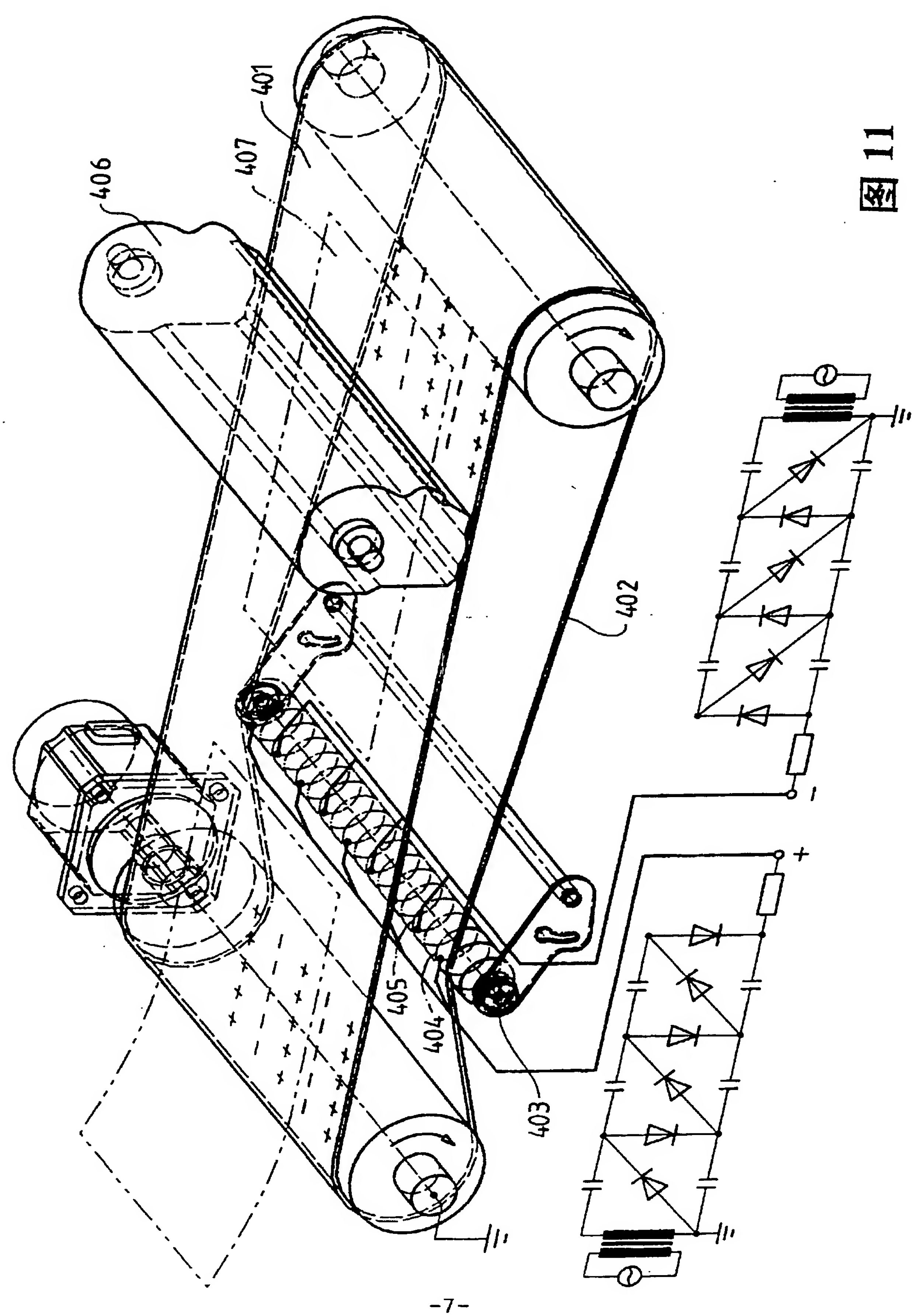


图 11

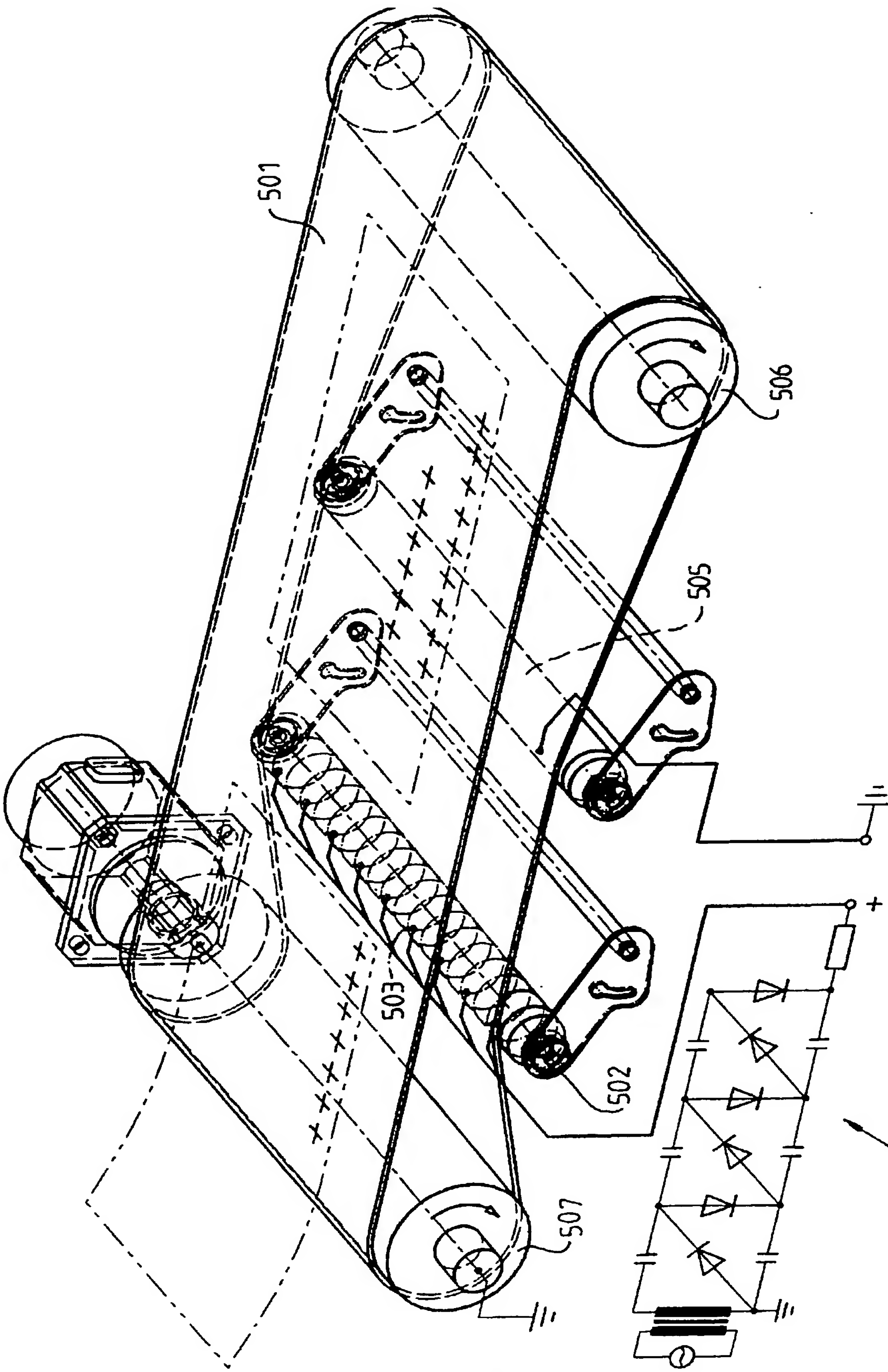


图 12

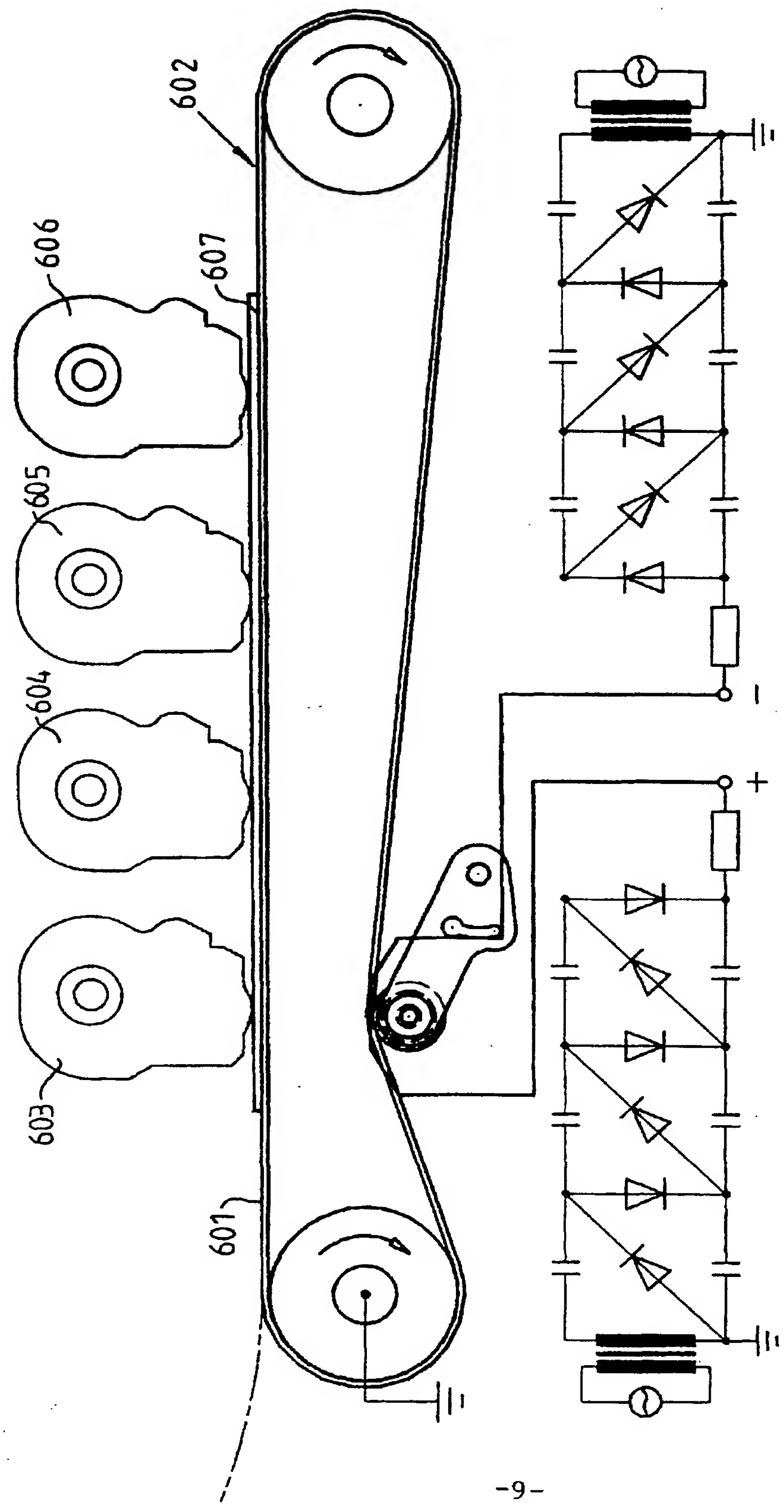


图 13

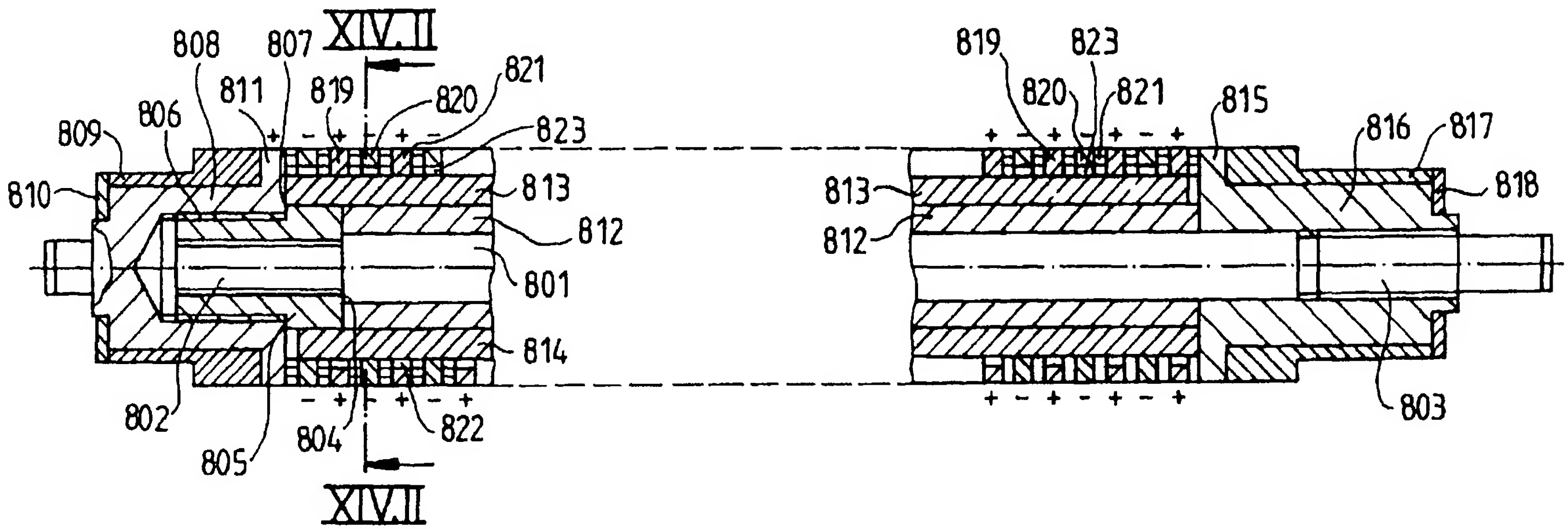

XIV.II
808
807
811
819
820
821
823
809
806
810
813
812
801
814
802
805
804
822
XIV.II
819
823
820
821
815
816
817
818
813
812
803

图 14.1

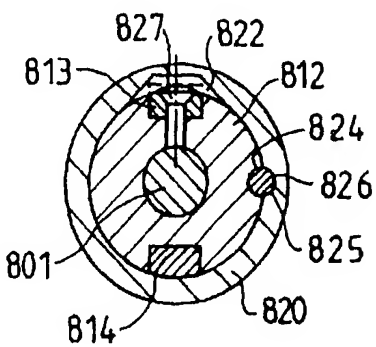

827
822
813
812
824
826
825
801
814
820

图 14.2

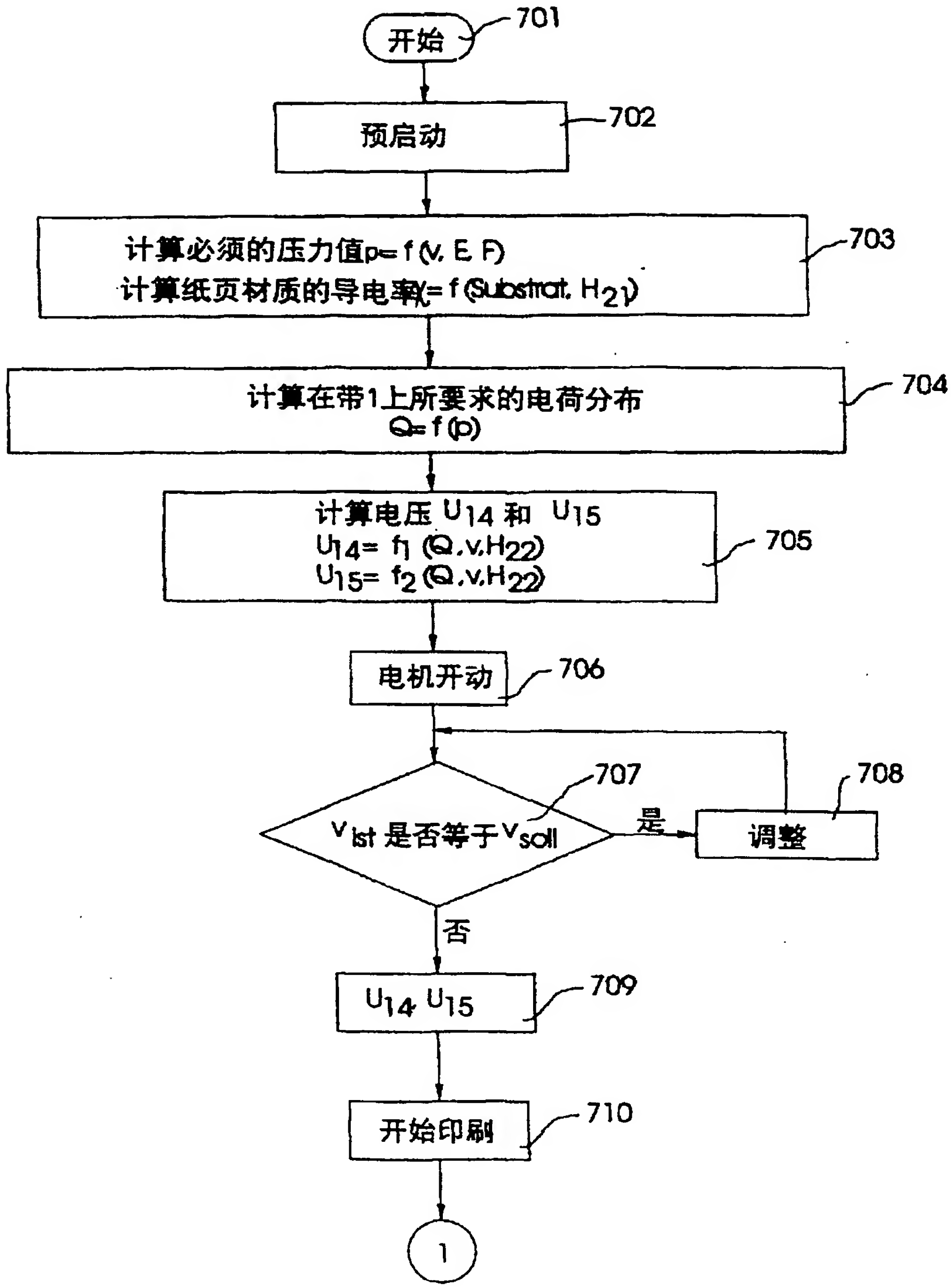

开始
701
预启动
702
计算必须的压力值p=f(V, E, F)
计算纸页材质的导电率χ=f(Substrat, H21)
703
计算在带1上所要求的电荷分布
Q=f(p)
704
计算电压 U14 和 U15
U14= f1 (Q,v,H22)
U15= f2 (Q,v,H22)
705
电机开动
706
Vist 是否等于 Vsoll
707
是
调整
708
否
U14 U15
709
开始印刷
710
1

图 15.1

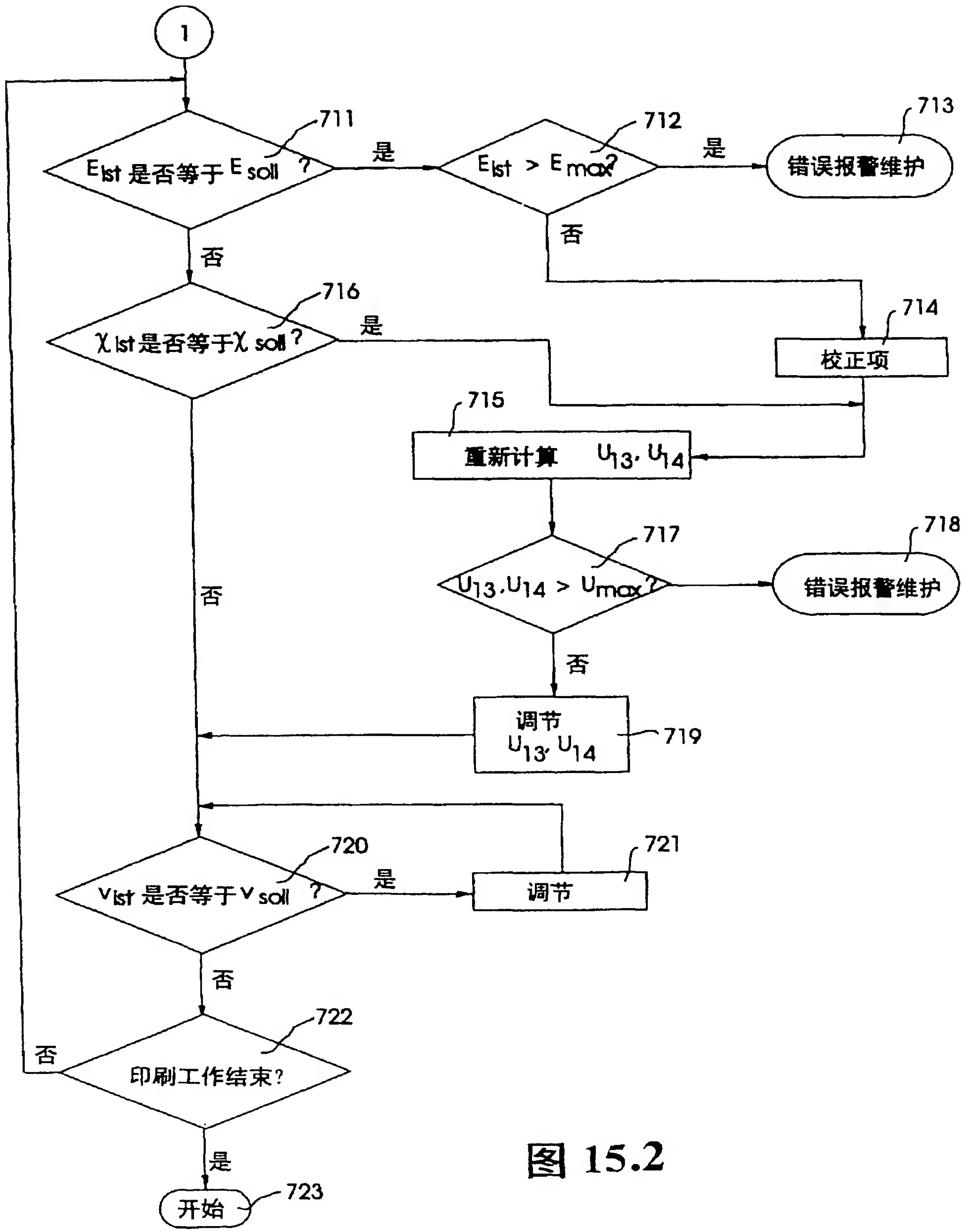

1
711
E_{Ist}是否等于E_{soll}?
是
712
$E_{Ist} > E_{max}$?
是
713
错误报警维护
否
否
716
χ_{Ist}是否等于χ_{soll}?
是
714
校正项
715
重新计算 U_{13}, U_{14}
717
$U_{13}, U_{14} > U_{max}$?
718
错误报警维护
否
否
调节
U_{13}, U_{14}
719
720
V_{Ist}是否等于V_{soll}?
是
721
调节
否
722
否
印刷工作结束?
是
开始
723

图 15.2

Re: Chinese Patent Application no.: 200480002912.7
Your Ref.: R03353 CLS

English translation of the reference 2 (CN1202867A)

Device for conveying sheets in a printing machine

BACKGROUND OF THE INVENTION

Field of the Invention

The invention relates to a sheet-conveying device for machines used in the printing technology field.

It has become known heretofore to hold thin workpieces such as sheets firmly and transport them with the aid of electrostatic devices. U.S. Pat. No. 4,244,465 discloses a device of that general type, whereby sheets are transported on a conveyor belt, wherein two groups of strip-shaped, equally spaced electrodes are integrated. The electrodes are surrounded by an insulating material and are connected to a high-voltage source, so that an electrostatic field is produced across the surface of the conveyor belt. A disadvantage of such a construction is that the electrodes revolve with the conveyor belt, which results in an increase in wear and tear of the electrodes and the conveyor belt. Furthermore, the structure of the electrodes rises above the surface of the conveyor belt, so that the contact surface is not completely even, which can be disadvantageous when transporting and processing thin sheets. The holding forces acting upon the sheets are reduced due to surface discharges; it may thereby become necessary to change the high-voltage polarity. The inhomogenous field created by the electrodes cannot be compensated for completely by the sheets, so that an increased deposit of dust is produced upon the conveyor belt. Due to a parasitic

corona which can be formed when the sheets are removed from the conveyor belt, surface charges accumulate in the insulating layer covering the electrodes. The surface of the conveyor belt may thereby become passivated, and the holding forces acting upon the sheet may accordingly be lost.

U.S. Pat. No. 4,526,357 describes a sheet separating or singling device which is based upon the same principle as that mentioned hereinabove.

The published European Patent Document EP 0 297 227 A2 shows an electrostatic holding device having electrodes pairwise embedded in a basic material and being connected to voltage sources which alternatingly change their polarity.

The published German Patent Document DE 4012 210 A1 discloses a sheet-conveying device with an endless belt wherein no electrodes are provided in the material of the belt. With the aid of an electrode which extends across the width of the belt and is in contact with an a.c.-voltage source, a charge-density pattern is formed on the surface of the belt by touching. The resulting non-uniform electrical field creates reflecting charges in the material of the sheets; thereby a holding power is generated to keep the sheets on the surface of the belt.

In order to attain uniform holding forces, the frequency of the a.c. voltage should be in phase with the revolving speed of the belt, which calls for expenditures involving control technology. Because the in-phase state cannot be realized completely, positively charged fields, for example, are charged negatively during the succeeding revolution of the belt. A corona effect produced by this change in charge causes ozone and nitrogen oxide to escape into the environment. The consumption of energy is increased. Particularly when the spacing between the positively and the negatively charged fields on the surface of the belt is rather slight, more changes in charge occur both when the belt runs into the effective range as well as when it runs out of the effective range of the charge electrode.

The use of a.c. voltage increases the tendency towards sliding discharges along the insulating surface of the belt. Due to the finite ohmic resistance on the surface of the belt, distances or spacings between the charges of more than 1 mm are optimal. It is thereby possible to deposit the sheets on the belt in such a manner that the edges of the sheets are at a given distance from a charge extremum. The maximal holding force cannot thereby act upon the sheet edges, which would be desirable for many uses.

In the construction according to the published German Patent Document DE 4012 210 A1, a blade-shaped electrode or a charge roller is provided having a large spatial range. When using high a.c. voltages, capacitive interferences with electronic control circuits may occur, which can only be reduced by providing additional shields, filters, and the like.

If the charging roller is to be used simultaneously as a tensioning roller for a belt having an inner conductivity, then a high capacity exists between the charging roller and the belt due to the looping angle. When a.c. voltage is applied, a high blind power and a high energy demand, respectively, result.

In U.S. Pat. No. 3,726,520, there is described a separating or singling device for sheets at the top of a sheet pile, whereby a cyclical reciprocally displaced foil or an endless belt being charged to a defined potential by a corona-charge source is used as a conveyor element. As the transported sheet approaches, it is attracted to the charged conveyor element and held there until a discharge of the conveyor element takes place. The sheets are also charged by static induction, however, the danger then exists that the sheets retain residual charges after they leave the conveyor element, which may be a hindrance in the further transport or further processing of the sheets. Particularly in electrostatic printing devices, residual charges on the printing material are a cause of printing errors or misprints.

SUMMARY OF THE INVENTION

It is accordingly an object of the invention of the instant application to provide a thin workpiece or sheet-conveying device for machines used in the printing technology field wherein a conveyor element of the device carrying the thin workpieces is of relatively simple construction and has a surface structure which does not hinder the transport and the process taking place in a respective machine used in the printing technology field and also has a long working life. Furthermore, the remaining residual or net charges on the thin workpieces and the negative environmental influences are minimized.

With the foregoing and other objects in view, there is provided, in accordance with the invention, a device for conveying thin workpieces for machines used in the printing technology field, including at least one movable conveying element having an electrically insulating contact surface supporting at least one workpiece as it is being conveyed, the contact surface of the conveying element being formed with regions of varying charge density by electric charges applied thereto, and the workpiece being held on the contact surface by electrostatic forces, comprising a multiplicity of contacts engaging the surface of the conveying element, the multiplicity of contacts including at least one given group thereof, the multiplicity of contacts being disposed transversely to a direction in which the thin workpiece is conveyable by the conveying element and being distributed across the entire width of the workpiece, the multiplicity of contacts being connected to at least one d.c. voltage source.

In accordance with another feature of the invention, the multiplicity of contacts engaging the surface of the conveying element include a plurality of different groups thereof, the contacts of the different groups being alternately connected to d.c. voltage sources of varying potential.

In accordance with a further feature of the invention, the group of contacts is formed

of coaxially arranged rings of like, diameter rollable off on the surface of the conveying element and connected to one another so as to be electrically conductive.

In accordance with an added feature of the invention, the contacts of all of the groups of contacts are arranged coaxially with respect to one another.

In accordance with an additional feature of the invention, the contacts are arranged on a cylinder formed of insulating material.

In accordance with yet another feature of the invention, the contacts are spaced a distance apart from one another, in a direction transverse to the conveying direction, the spaced distance being adjustable in accordance with the dimensions of the thin workpiece to be conveyed.

In accordance with a concomitant feature of the invention, the one group of contacts engaging the surface of the conveying element is connected to a d.c. voltage source; and an electrostatic charge device is disposed upstream of the group of contacts, as viewed in the conveying direction, for generating on the surface of the conveying element a homogeneous charge having a potential which is the opposite of the potential of the d.c. voltage source.

Belts or cylindrical bodies can be used as conveying elements. It is essential that the conveying element contains a homogeneous layer of dielectric material. Electric charges with a constantly varying polarity are applied to the sheet-contact surface of the conveying element. It is thereby possible to transport on the conveying element all types of sheet materials upon which forces act in an inhomogenous electrical field. An especially suitable sheet material is ordinary paper.

In the case of machines in the printing technology field having a plurality of sheet-processing stations, several conveying elements may be arranged behind or in

parallel with one another. Depending upon the requirements, conveying elements which are designed as belts may have straight-lined conveying paths or paths with random curves aided by suitable guiding elements. If the process in or at a respective machine requires, the sheet-contact surface of the conveying element need not be planar and, due to the electrostatic forces, the sheets can virtually assume the shape of the contact surface.

No electrodes are integrated in the conveying elements, as they could wear out prematurely in the case of a belt-type conveying element. Due to the fact that, with the electrodes being situated in the carrier body, charges of opposite polarities are impressed into the insulating layer of the conveying element, almost no residual charges or net charges which could disturb the further transport can build up on the sheets. The amount of charge is almost completely equalized, so that, towards the outside, the insulating layer of the conveying element is electrostatically neutral. The charges are maintained at least during transport. The conductivity on the surface of the insulating layer may be so dimensioned that the holding forces decrease during transport and have almost entirely vanished at the end of the conveying path.

It is possible to neutralize the charges remaining before new charges are applied, so that a defined section of the conveying element is not polarized. Suitable materials for the insulating layer, whereon the applied charges are partially maintained, are suitable synthetic materials like polyester, polycarbonates, polyimides or PTFE.

In order to keep the holding forces of the sheets on the conveying element constant, it is possible to operate the device producing the charges with variable voltages or to arrange or change the spacing of the electrodes applying the charges onto the conveyor belt in a manner that the desired distribution and amount of holding forces are present across the contact surface. When a printed or coated sheet is to be transported, the charge distribution and the local amount of charge can then be produced in correspondence with the printed image or the coating.

Because electric charges are very much dependent upon atmospheric conditions and upon changes in material properties of the conveying elements and of the sheets, it is possible to change the charge distribution and the local amount of charge to be applied in accordance with these conditions or properties. For this purpose, respective sensors can be used which detect, for example, the humidity, the barometric pressure, the air temperature and the moisture of the sheet material. The sensor signals can be transmitted to a control unit which, after having processed the signals, actuates respective adjustment elements of the devices producing the charge. Thus, control or regulation of the charge distribution and the local amount of charge is feasible.

Other features which are considered as characteristic for the invention are set forth in the appended claims.

Although the invention is illustrated and described herein as embodied in a sheet-conveying device for machines used in the printing technology field, it is nevertheless not intended to be limited to the details shown, since various modifications and structural changes may be made therein without departing from the spirit of the invention and within the scope and range of equivalents of the claims.

The construction and method of operation of the invention, however, together with additional objects and advantages thereof will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary diagrammatic and schematic view of a sheet-conveying device for machines used in the printing technology field including a belt-type conveyor or transport element;

FIG. 2 is a diagrammatic side elevational view of an embodiment of a charge roller forming part of the sheet-conveying device of FIG. 1;

FIG. 3 is a fragmentary diagrammatic plan view of the belt conveyor of FIG. 1 having a charge distribution depicted thereon;

FIG. 4 is a diagrammatic perspective view of another embodiment of the charge roller having ring-like electrodes in accordance with the invention;

FIG. 5 is a fragmentary diagrammatic plan view of a charge distribution when ring-like electrodes are used;

FIG. 6 is a diagrammatic perspective view of a further embodiment of the charge roller having spiral-like electrodes;

FIG. 7 is a fragmentary diagrammatic plan view of a charge distribution when spiral-like electrodes are used;

FIG. 8 is a schematic and diagrammatic perspective view of a first embodiment of the sheet-conveying device according to the invention which has two charge rollers and a single-layer conveyor belt;

FIG. 9 is a view like that of FIG. 8 of a second embodiment of the sheet-conveying device having one charge roller with two groups of ring-like contacts;

FIG. 10 is a view like those of FIGS. 8 and 9 of a third embodiment of the sheet-conveying device having two charge rollers and a two-layer conveyor belt;

FIG. 11 is a view like those of FIGS. 8, 9 and 10 of a fourth embodiment of the

sheet-conveying device having one charge roller and a two-layer conveyor belt;

FIG. 12 is a view like those of FIGS. 8 to 11 of a fifth embodiment of the sheet-conveying device having one charge roller and one grounding roller at a two-layer conveyor belt;

FIG. 13 is a schematic and diagrammatic side elevational view view of the conveyor belt of the sheet-conveying device according to the invention with several printing units arranged along the conveyor belt;

FIG. 14.1 is a longitudinal sectional view partly broken away, of an embodiment of a charge roller forming part of the device according to the invention;

FIG. 14.2 is a cross-sectional view of FIG. 14.1 taken along the line XIV.II--XIV.II in the direction of the arrows; and

FIGS. 15.1 and 15.2 are respective portions of a flow chart illustrating the mode of operation of the device according to FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings and, first, particularly to FIG. 1 thereof, there is shown therein a conveyor belt 1 wound around two guide rollers 2 and 3. The conveyor belt 1 is formed of a dielectric material. The guide roller 2 is coupled with a drive motor 4. The thus-illustrated arrangement further includes a feed table 5 and a delivery table 6 for thin workpieces or sheets 7 to be transported. A lower and slack side or strand of the conveyor belt 1 is engaged by a charge roller 8 which is rotated by friction as the belt 1 revolves. Opposite the charge roller 8 is a grounding roller 52 connected to ground potential at 15 and rolling off on the inside of the conveyor belt 1. In the surface of the charge roller 8, two groups of electrodes 9 and 10 are arranged and are

connected to respective adjustable high-voltage sources 13 and 14 via respective slip rings 11 and 12.

The electrodes 9 are connected to a negative potential 16 which is opposite to the ground potential 15, while the electrodes 10 are connected to positive ground potential 17. The high-voltage sources 13 and 14 have respective control inputs 18 and 19 which are connected to a suitable control unit 20. The control unit 20 is furthermore connected to moisture sensors 21 and 22 for detecting surface moisture of the sheets 7 and humidity in the environment of the charge roller 8. The control unit 20, besides being connected to the moisture sensors 21 and 22, can also be connected to further, non-illustrated sensors, for example, to sensors for detecting atmospheric pressure and air temperature.

FIG. 2 illustrates diagrammatically how the electrodes 9 and 10 extend, in a substantially uniform distribution, across the entire width of the charge roller 8.

The conveyor belt 1 is charged with alternating polarity for conveying the thin workpieces or sheets 7. An exemplary distribution of the charges 23 and 24 on the contact surface of the conveyor belt 1 is illustrated in FIG. 3. In accordance with the arrangement of the electrodes 9 and 10 illustrated in FIG. 2, the negative charges 23 and the positive charges 24 alternate in series in a direction represented by the horizontal arrow 25. The charging of the conveyor belt 1 is effected by the charge roller 8. The high-voltage sources 13 and 14 are set to a substantially equal though opposite voltage via the control voltages at the control inputs 18 and 19. At the electrodes 9 and 10 opposite the grounding roller 52, a static electric field is formed which, due to the contact with the conveyor belt 1 and due to the corona effect, creates virtual electrodes on the conveyor belt 1. When a sheet 7 is deposited, a force is exerted upon the sheet 7 in a vertical direction with respect to the surface of the conveyor belt 1, as shown in FIG. 1. At the end of the path over which the sheet 7 is conveyed by the conveyor belt 1, the sheet 7 is further transported from the conveyor

belt 1 to the delivery table 6 by a non-illustrated removal device. The surface resistance of the convey belt 1 can be dimensioned so that the charges 23 and 24, due to a creeping or surface leakage current, are equalized, until the transfer position is reached. The yet remaining holding forces can easily be overcome by the removal device. The local charge quantity can be varied in accordance with the signals of the moisture sensors 21 and 22. The speed of the motor 4 and the amount of charge to be applied can likewise be coordinated by the control unit 20 when the signals are processed by an incremental rotary encoder 26 coupled with the shaft of the motor 4.

In FIG. 4, a further embodiment of the charge roller 27 is illustrated. The electrodes 28 and 29 are embedded circumferentially in the surface of the charge roller 27 in a ring-like manner. Every second electrode 28, 29 is connected to one another and positioned on respective slip rings 30, 31. When a d.c. voltage essentially symmetrical to ground is applied to the slip rings 30 and 31, a charge distribution as shown in FIG. 5 is formed on the surface of the conveyor belt 1. Besides the herein aforedescribed dependence of the amount of d.c. voltage upon the transport speed, the humidity in the air and the moisture of the sheets 7, the d.c. voltage can also be varied in accordance with the size and the spacing of the sheets 7 and in accordance with the printed image on the sheets 7. For this purpose, an edge detector and an image exposure or pick-up device may be provided along the conveying path, and the signals therefrom may be processed in a control device.

FIG. 6 shows an embodiment of a charge roller 41 having two electrodes 42 and 43 which are disposed in spiral form on the surface. The uniformity of the distribution of the charges 23 and 24 in the dielectric layer 39 of the conveyor belt 1 may thereby be improved. Such a charge distribution is shown in FIG. 7.

If a stronger holding force in the dielectric layer of the conveyor belt 1 is desired, two of the hereinaforedescribed charge rollers 8, 27 and 41, which rotate synchronously and are arranged directly behind one another, may be provided. It is thereby possible

to vary the areas of the charge-islands.

The invention is not limited to the arrangement shown herein. Several conveyor belts 1 in compound arrangement, as well as conveyor belts 1 which cooperate with one or more transport drums maybe installed. It is also possible to provide several charging devices in touching and/or non-touching arrangement at a conveying element 1 for enabling a regeneration of the charges 23 and 24 over a very long conveying path.

When a single-layer conveyor belt 1 of dielectric material is used, the charging devices can also act upon the side facing away from the charging surface for the sheets 7, the material of the sheets 7 being able to be used as a counter electrode, or a grounded press-on roller may be used as a counter electrode. In the latter case, the effects of the forces can also be realized on non-conductive substrates. Furthermore, advantages are attained in the feeding and the removing of the sheets 7 and, with regard to the dust, which has an influence upon the charge relationships.

FIG. 8 illustrates an embodiment of a conveying device with two charge rollers 101 and 102. The conveyor belt 103 is supported by two guide rollers 104 and 105 and one tension roller 106. The guide roller 104 is coupled with a drive motor 107. The charge rollers 101 and 102, respectively, are formed of equidistant and coaxially arranged rings 108. The rings 108 of the charge rollers 101 and 102 are at the same potential. The rings of the charge roller 101 are connected to a negative d.c. voltage source 109, and the rings 108 of the charge roller 102 are connected to a positive d.c. voltage source 110. Each d.c. voltage source 109,110 includes a high-voltage transformer 111, a cascade of capacitors 112 and diodes 113 and a barrier or series resistance 114. The charge rollers 101 and 102 or the rings 108 contact the surface of the conveyor belt 103 in the looping region around the guide roller 104. The guide roller 104 is connected to ground potential. When the conveyor belt 103 is moving, the rings 108 of the charge rollers 101 and 102 roll off on the surface of the conveyor belt 103. Through a displacement of the rings 108 of the charge rollers 101 and 102 in

axial direction around a half of the distance between the rings 108, a charge pattern 115 (only partially illustrated in FIG. 8) is created on the surface of the conveyor belt 103. The charge pattern 115 contains traces of positive and negative charges 116 and 117. The traces are disposed in the conveying direction and have the same spacing from one another as the rings 108. A sheet 118 disposed on the surface of the conveyor belt 103 is held by the charges 116 and 117.

An additional embodiment of the conveying device according to the invention shown in FIG. 9 provides only a single charge roller 201. This charge roller 201 includes two groups of contact rings 202 and 203 which are arranged coaxially and alternatingly with respect to one another. Each group of contact rings 202 and 203 is connected with a separate d.c.-voltage source 204, 205 of opposite polarity.

An embodiment of the conveying device according to FIG. 10 provides a two-layer conveyor belt 301. For generating a charge pattern on the surface of the conveyor belt 301, two charge rollers 303 and 304 are arranged in the lower portion 302 of the conveyor belt 301, the charge rollers 303 and 304 being mounted in a respective swivelable holder 305 and 306. The charge rollers 303 and 304 exert pressure on the conveyor belt 301, thereby subjecting the latter to tension. The surface of the conveyor belt 301 facing the sheets 307 is formed of insulating material, while the inner surface of the conveyor belt 301 moving over the guide rollers 308 and 309 is electrically conductive. As opposed to the one-layer construction of the conveyor belt 301 according to FIGS. 8 and 9, the embodiment according to FIG. 10 makes it possible for the sheets 307 to be deposited with a sufficient holding power also outside of the looping region 310 of the conveyor belt 301, due to the mirror-image charges being created.

FIG. 11 shows another embodiment similar to the embodiment of FIG. 9, however, with a two-layer construction of the conveyor belt 401. The charge roller 403 arranged at the lower side or strand 402 of the conveyor belt 401 includes two groups

of contact rings 404 and 405, just like the charge roller 201 in FIG. 9. The charge roller 403 functions simultaneously as a press-on roller for tensioning the conveyor belt 401. As a sheet 407 on the conveyor belt passes a printing unit 406, it can be printed on by the printing unit 406.

FIG. 12 shows a further embodiment of the conveyor device which has a characteristic feature that only one charge roller 502 with only one group of contact rings 503 is assigned to a conveyor belt 501 of a two-layer construction. The contact rings 503 are connected to a d.c. voltage source 504. A grounding roller 505 is arranged in front of the charge roller 502. When the conveyor belt 501 moves around the guide rollers 506 and 507, the charge density pattern remaining on the surface of the conveyor belt 501 is eliminated. The surface of the conveyor belt 501, in the lower side or strand thereof between the grounding roller 505 and the charge roller 502 is neutralized to ground potential. Through the contact rings 503 connected to the positive-pole of the d.c. voltage source 504, positive charge traces with a spacing corresponding to the spacing of the contact rings 503 are created on the surface of the conveyor belt 501, as illustrated in FIG. 12.

In a non-illustrated alternative embodiment, the grounding roller 505 can be connected to a negative d.c. voltage source. In such a case, the negative charges would be changed into positive charges through the contact rings 503, the charge traces between the contact rings 503 then remaining at negative potential. The charge-density pattern created thereby corresponds to that shown in FIG. 11, for example.

From FIG. 13, it is apparent that the conveying device according to the invention, can be part of a printing unit. Four printing units 603 to 606 are assigned to the upper side or strand 601 of the conveyor belt 602 shown in FIG. 13, so that a passing sheet 607 can be printed in four colors. The charges created on the conveyor belt 602 can be so dimensioned that, for transferring the printing ink or the toner particles from the

printing units 603 to 606 to the sheet 607, electrostatic forces can be brought to act upon the printing ink or on the toner particles.

FIGS. 14.1 and 14.2 show an alternative construction of a charge roller as has been used in the embodiments of FIGS. 4, 9 or 11. The charge roller has a shaft 801 with threaded ends 802 and 803. An electrically insulating part 805 is screwed to an abutment surface 804 of the shaft 801. Onto a male screw thread 806 and to an abutment surface 807 of the part 805, there is screwed a tubular part 808 which is electrically conductive. The part 808 is surrounded by insulating parts 809 and 810. The part 808 has a flanged end. The outer surface of the flange 811 forms a first contact surface which is positively charged when the part 808 is connected to a positive d.c. voltage source. On the shaft 801, there is disposed a cylindrical electrically insulating part 812 having the same diameter as the largest outer diameter of the part 805. Distribution strips 813 and 814 are embedded in the part 812 along the outer surface thereof. The distribution strip 813 for the positive potential contacts the flange 811 endwise. The distribution strip 814 contacts a flange 815 of a tubular part 816 which is screwed onto the threaded end 803. The outer surface of the flange 815 forms a contact surface which is negatively charged, whereas the part 816 is connected to a negative d.c. voltage source. The part 816 is surrounded by insulating parts 817 and 818. On the outer surface of the part 812, there are arranged groups of contact rings 819 and 820, with insulating discs 821 disposed therebetween. The first group of contact rings 819 is in contact with the distribution strip 813 and thereby connected to a positive potential. The second group of contact rings 820 is in contact with the distribution strip 814 connected to a negative potential. The contact rings 819 and 820 are formed with recesses 822 and 823 in order to bypass or bridge the distribution strips 813 and 814 with opposite polarity. On the outside of the part 812 and on the inside of the contact rings 819 and 820 there are provided semi-cylindrical recesses 824 and 825 into which an insulating cylindrical part 826 is inserted in order to secure the contact rings 819 and 820 against relative rotation. The distribution strips 813 and 814 are fastened in the part 812 by screws 827. The connections of the

parts 806 and 816 to the d.c. voltage sources are not illustrated. These connections may be made through conventional sliding contacts.

In accordance with FIGS. 15.1 and 15.2 and the diagrammatic and schematic view of FIG. 1, the function of the control device 20 in connection with the transport of sheets 7 through a printing press is described as follows:

The flow chart according to FIGS. 15.1 and 15.2 includes, in addition to a starting step 701, a step 702 to perform preadjustments or presettings. In step 702, all order-related data, such as type of paper, paper thickness, paper moisture, paper format and number of prints are input. In a step 703, the necessary or required press-on pressure p of the substrate or sheet 7 on the conveyor belt 1 and the conductivity .chi. of the material of the sheet 7 are calculated from these specific order data. In calculating the necessary or required press-on pressure p, the printing speed v, the field intensity E in the material of the sheet 7 and the force F created on the sheet 7 by the action of a printing unit, amongst others, are taken into consideration. The conductivity .chi. of the sheet 7 results from the material properties of the sheet 7 and the moisture H21, detected by the sheet-moisture sensor 21. In a step 704, the necessary or required charge distribution Q on the conveyor belt 1 is calculated by using the press-on pressure p calculated in step 703, the distance or spacing of the electrodes 9 and 10 between one another being taken into consideration. In a further step 705, the amount of the voltages U13 and U14 are calculated, the amount thereof depending upon the charge distribution Q calculated in step 704, upon the speed v of the conveyor belt 1 and upon the environmental humidity H22. The humidity H22 is detected by the humidity sensor 22. After the aforedescribed preadjustments or presettings and the calculations made in the steps 702 to 705, the motor 4 can be switched on in a step 706. When, in a step 707, it is determined that the actual speed vactual of the conveyor belt 1 is not in correspondence with the reference speed v, then the number of--rotations of the motor 4 is regulated in a step 708. When the reference speed vreference is reached, the voltages U13 and U14 are

applied to the electrodes 9 and 10 in a step 709. As soon as a sheet 7 held on the conveyor belt 1 arrives at the printing unit, the printing unit is set into operation in a step 710. During printing on the sheets 7, continuous checking is performed in a step 711 as to whether the field intensity Eactual present in the material of the sheets 7 corresponds with the reference field intensity Ereference. When the present field intensity Eactual is greater than the reference field intensity Ereference, which is checked in a step 712, then a fault-message is emitted in a step 713. Otherwise, correction terms are created in a step 714, by which, in a step 715, the amounts of the voltages U13 and U14 are calculated anew. In a step 716, a check is made as to whether a change in conductivity .chi. as a result of changes in the surface moisture H21 of the sheets 7 or as a result of changes in the humidity H22 in the air has occurred. If this is the case, the amounts of the voltages U13 and U14, in the step 715, are corrected according to the change in conductivity. In a step 717, a check is made as to whether the voltages U13 and U14 exceed a maximal value UMAX. If this is the case, a fault-message is emitted in a step 718. When the voltages U13 and U14 lie within the permitted range, then, in a step 719, the high-voltage sources 13 and 14 are set to the new values U13 and U14 via the control inputs 18 and 19. In a step 720, the actual speed vactual b of the conveyor belt 1 is continuously compared with a reference speed vreference. If there is a deviation from the reference speed vreference, regulation of the speed takes place in a step 721. Finally, continuous checking is performed in a step 722 as to whether a prescribed number of sheets 7 have already been printed. If not, then the steps 711 to 722 are repeated, until the preset number of sheets is reached. The printing process is completed with the step 723.